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## FOREWORD

This issue of the *ICF Quarterly* contains six articles reporting recent advances in target physics and National Ignition Facility (NIF) laser development within the ICF Program.

Three articles are related to target physics experiments on Nova. For indirect-drive ICF, laser light is converted in a hohlraum to x rays, which drive the capsule implosion. "X-ray Production in Laser-Heated Xe Gas Targets" (p. 43) describes experiments demonstrating that high x-ray conversion efficiency can be achieved in an underdense gas target, requiring less laser energy than conventional solid targets. These targets also produce a brighter x-ray source than high-Z solid targets, which is valuable for backlighter beams and for radiation effects testing. High-gain direct-drive ICF requires very uniform laser irradiation to create a spherical implosion. Asymmetric convergence of the capsule can be caused by the Rayleigh–Taylor instability, which can result from the imprinting of laser nonuniformities. The article "Measurement of a 0.35- $\mu\text{m}$  Laser Imprint in a Thin Si Foil Using an X-ray Laser Backlighter" (p. 49) examines the effect of beam smoothing on laser imprinting at the time of shock breakout, both experimentally and theoretically. "Studies of Energy Transfer Between Crossing Laser Beams in Plasmas" (p. 82) addresses the issue of energy transfer between drive beams in a plasma, which can be detrimental to the implosion symmetry and fusion yield. In the NIF, laser beams with different intensities and different angles will cross at the hohlraum entrance, creating the potential for energy transfer between beams. Experiments and theory demonstrate that energy transfer requires the correct angle and beam frequency to satisfy the phase-matching requirements for energy transfer. By setting different beam lines to different frequencies, the potential for energy transfer may be suppressed.

The interaction of short-pulse lasers with plasmas has gained increasing attention due to the Fast Ignitor concept of ICF. The intensity of the ignition laser is expected to be so high that the linear analysis of the absorption of laser light in an overdense plasma is no longer valid, and collisional absorption mechanisms become important. The article "Absorption of Laser Light in Overdense Plasmas by Sheath Inverse Bremsstrahlung" (p. 55) describes a new theoretical model that includes the sheath inverse bremsstrahlung and anomalous skin effects. Simulations using this model provide a criterion for determining the parameters used in numerical simulations of the high-laser-intensity regime of the Fast Ignitor.

The main technical goal of the NIF is to achieve ignition through ICF. Such ignition will produce a burst of radiation, including neutrons, x rays, gamma rays, and secondary neutrons, which could reduce the transmission of the final laser optics. "Radiation-Effects Testing for the NIF Final Optics" (p. 61) discusses an extensive set of experiments, conducted at several different facilities, designed to address the issue of radiation damage in fused silica and KDP. These experiments demonstrate that, with careful selection of starting materials, the NIF final optics should have minimal loss of transmission due to absorption of radiation over the facility lifetime.

The article "Temporal Pulse Shaping of Fiber-Optic Laser Beams" (p. 75) discusses the design and performance of a computer-controlled arbitrary waveform generator for the NIF. Temporal pulse shaping is required on each beamline of the NIF to correct for pulse distortion due to gain saturation in the amplifier chain and to achieve power balance between the beams. This versatile device has been successfully prototyped on the Beamlet laser.

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